CIVILISATION AND EYESIGHT

IN his interesting paper on "The Influence of Civilisation upon Eyesight," read recently before the Society of Arts, Mr. Brudenell Carter supports the commonly received view that the vision of savages is far more acute than that of civilised men. In some sense this is doubtless true; but that the eyes of savages, considered merely as optical instruments, are greatly superior to our own appears to be inconsistent with optical laws and facts long since established by the labours of Airy, Helmholtz, and other investigators. It is known to physicists that the resolving power of an optical instrument is limited by its *aperture*. With a given aperture no perfection of execution will carry the power to resolve double stars, or stripes alternately dark and bright, beyond a certain point, calculable by the laws of optics from the wave-length of light. With sufficient approximation we may say that a double star cannot be fairly resolved unless its components subtend an angle exceeding that subtended by the wave-length of light at a distance equal to the aperture. If we take the aperture of the eye as 1 5th inch, and the wave-length of light as 1-40,000th inch, this angle is found to be about 2 minutes; and we are forced to the conclusion that there is no room for the eye of the savage to be much superior in resolving power to those of civilised physicists, whose powers approach at no great distance the theoretical limit as determined by the aperture.

It has always appeared to me that the superiority of the savage is a question of attention and practice in the *interpretation* of minute indications, and that it is comparable with the acuteness of the blind in drawing conclusions from slender acoustical premises. It would be an interesting subject for investigation, but I should not expect to find that when put to a direct test blind people were able to hear sounds wholly inaudible to others.

The increasing prevalence of short sight is a very important matter, worthy of all attention. There is one fact in connection with it which I avail myself of this opportunity of mentioning, in the hope of inducing scientific oculists to give it further examination. I find that, though not at all short-sighted under ordinary circumstances, I become decidedly so in a nearly dark room, seeing much better with spectacles of 36 inches negative focus. In a moderately good light I see rather better without the glasses than with them. From the few observations that I have made I have reason to believe that this peculiarity of vision is not uncommon. With the aid of a set of concave glasses it is easy to try the experiment in a room lighted with gas. The flame should be gradually turned lower and lower, so as to give full time for the pupil to dilate, and for the eye to acquire its maximum sensitiveness. In my own case the most marked indication of better definition is the augmentation of binocular relief. RAYLEIGH

THE INTERNATIONAL INVENTIONS EXHIBITION

THERE seems now little reason to doubt of the success of the South Kensington Exhibition of next summer—success, that is, from an educational and scientific point of view. What its financial result may be depends upon a variety of circumstances, and perhaps, since it is very improbable that there can be any serious deficit, while, if there is a large surplus, its disposal will, as usual, form a problem difficult of solution, this part of the question does not really very much matter. That Londoners will have a pleasant outdoor lounging place, that there will be abundance of music, that the fountains will be as pretty as last year and the gardens prettier, all this may be taken for granted; but there now seems every reasonable expectation that we shall have more than this, and that the Exhibition will be what it professes to be—a complete illustration of the progress made in the application of science to industry during the past twenty years. At all events if it is not it will be the fault of the promoters, since they have had so large a range of choice that it has only been possible to find space for some third of the applicants, and an enormous number of exhibits have been rejected, not because they were unsuitable or uninteresting, but simply because, when there was not room for all, some must of necessity be excluded.

To begin with, it was thought best to exclude, not only the actual articles which were shown last year, but inventions of the same class, and consequently there will be found at South Kensington this year few, if any, exhibits relating to food, clothing, or sanitation. It appears that this rule has given rise to a certain amount of heart-burning, since reference is found to all these heads in the official classification; but it must be remembered that the announcement was duly made at the beginning that the space to be allotted to these and certain other classes would be strictly limited, and then again it was impossible to foresee how large would be the response to the invitations issued. The task of selection has been a difficult, and indeed an invidious, one; but we think it will be found, when the show is opened in May next, that this thankless task has been performed with great judgment, and with a just consideration of the claims of exhibitors on the one hand, and the interest of the public on the other.

We are glad to have heard that in none of the thirty-one groups into which the inventions' half (we are not now considering the musical part) of the Exhibition is divided, have the applications been deficient; in some they are naturally better than others, but in every one there is enough to provide a fair representation of the condition of its particular industry, and of the improvements which have been made in it during the limits of time with which the Exhibition is concerned. Even this will doubtless be a cause of complaint to those who believe that injury will be done to our manufacturers by the opportunity given to foreigners of imitating our wares and the methods by which they are produced. This is a specious but a somewhat narrow-minded notion; the early history of invention is full of stories of the efforts of inventors to keep their inventions secret, and the constant failure of such efforts may be taken as one of the principal causes which produced the modern Patent system, under which an inventor is protected, so far as law can protect him, in the enjoyment of the property he has created. There are, of course, many instances of processes worked, and successfully worked, in secret; but these are the exception, and on the whole it is found that inventors individually, and industry generally, gain far more by a system of publicity than by one of concealment. So it is with exhibitions. It may be taken as tolerably certain that manufacturers who have any special process which they desire to keep to themselves will not select that particular process for exhibition, and that on the whole manufacturers find exhibitions profitable or they would not be so anxious to engage in them. The suggestion that was made by some wiseacre that the Exhibition should be confined to untried inventions, so that manufacturers (who of course have no other means of hearing of novelties in their own trades) might have the benefit of seeing them, does not, perhaps, call for serious refutation. If the curious collection of rubbish which fills the big building at Washington, devoted to the United States Patent Office, were carted across the Atlantic, and placed in the Kensington Galleries, it is a question whether the public would be more bored, or the manufacturers less instructed.

As would naturally be expected, in an exhibition of this character, machinery will occupy a far larger proportion of the space than on previous occasions; we understand that it has therefore been necessary to make considerable additions to the motive power provided for the

use of exhibitors. Besides the engine which supplied power in the machinery gallery last year, an engine is being erected in the new gallery which is being put up along the north side of the old South Gallery, as described in the *Journal* of the Society of Arts for January 30. A third engine will also be provided, which will drive machinery in one of the Foreign Courts. It will thus be seen that those visitors who have mechanical tastes will be amply provided for.

As regards the prospects of applied chemistry, we are not able to speak so confidently. Probably the completeness of this portion of the show will almost entirely depend on the success of the efforts which are being made by the Society of Chemical Industry to secure a collective exhibit. The announcement made by the executive at the outset, that it was desired to show processes rather than products, is believed to have kept back many manufacturers from seeking to show specimens, while it is obvious that but few chemical processes could conveniently be carried on in an exhibition gallery. Possibly this rule might have been abrogated as regards the chemical section, and we believe that no attempt will be made to enforce it with reference to the collection of the Society of Chemical Industry, in which it is proposed that the information required shall be given by means of a collection of pictorial diagrams, exemplifying some of the more interesting or more important chemical operations.

As our readers are aware, a similar work is being undertaken by the Physical Society in the class devoted to "Philosophical Instruments and Apparatus," though in this case there will be less left for the society to do, since the principal makers of apparatus have come forward in sufficient numbers to ensure a good representative collection. The object, however, of the Society in exhibiting has been not so much to supply deficiencies, as to show the work which has been done by its own members. We believe that the Kew Observatory and the Meteorological Society will also be among the exhibitors, the latter in their old place in the grounds. Besides this, a very interesting exhibit is promised—namely, a fully fitted observatory, which we understand one of our best known makers had offered to fit up.

In the class devoted to Photography, which comes next both in the classification and in actual position in the galleries to the philosophical instruments, the Photographic Society has undertaken to form a collection of apparatus and specimens not likely to be shown by makers. It appears that the Society intend to go a little beyond the precise limits of the Exhibition, and to show a collection of examples illustrating the entire progress of photography from the inventions of Niepce and Daguerre, and it may doubtless be assumed that in so special a case no objection will be raised, especially as but a very small space indeed, and that only on the walls, will be required for what cannot fail to prove a most instructive and interesting collection.

The progress which has been made in electric lighting has indeed been sufficiently illustrated in the exhibitions of last and of the preceding year; in fact, the Health Exhibition offered almost the only public example of any progress at all in England. Doubtless the lesson will be repeated this year, and on a more extended scale, for we learn that considerable additions are being made to the arrangements for electric lighting of the buildings, while it is intended to use the light also for the garden illuminations, an improvement due to the energy of Sir Francis Bolton. If this idea is carried out on the plan which we understand is intended, the instantaneous lighting up of the myriad incandescent lamps by which the gardens are to be illuminated will certainly be one of the most popular, and one of the most wonderful, sights in London next summer.

The above remarks refer only to the English portion of the Exhibition. How much will be contributed by foreign countries it is not yet possible to ascertain. Thanks doubtless to the efforts which were made by certain of the members of the British Association who were in the States last year, the American Court promises to be well filled, and it must be admitted that in the present Exhibition, if we get American ingenuity well represented, we shall not very greatly miss the contributions of other countries, though we hope, all the same, that these will not be lacking.

THE RETINA OF INSECTS

IT might have been thought impossible for any one who has studied the eyes of Arthropods to doubt that the so-called retinulæ are really the nerve-end cells of the eye, and correspond with the rods and cones of the vertebrate eye. The evidence in favour of this view accumulated by the researches of almost every observer, including such eminent authorities as Johannes Müller, Leydig, and Grenacher is so overwhelming that of late years no one has thought fit to dispute it.

Mr. Lowne has, however, at last attempted to overthrow this theory, and in a paper just published in the *Transactions* of the Linnean Society, vol. ii. part ii., on "The Compound Vision and the Morphology of the Eye in Insects," has brought forward certain statements to prove that all the parts of the eye in front of the basilar membrane are dioptric, whilst the true (?) retina is situated behind it.

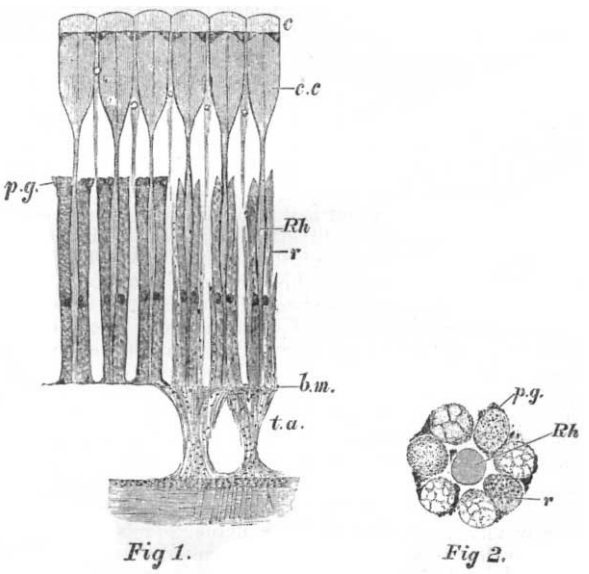

Fig 1. Fig 2.

FIG. 1.—Section through the eye of Squilla, showing the distribution of the ultimate nerve fibrils to the retinulæ. The Ommatidia to the left of the figure are drawn with their accompanying pigment cells (*p.g*) complete; in the three to the right these are omitted in order to show more clearly the distribution of the nerve fibrils; *c*, corneal facets; *c.c*, crystalline cone; *rh*, rhabdom; *r*, retinula; *b.m*, basilar membrane; *t.a*, terminal anastomosis of optic nerve fibrils supplying the retinulæ.

FIG. 2.—Transverse section through the ommatidium of Squilla, showing the seven retinula cells surrounding the central rhabdom. The retinulæ are seen to possess a considerable amount of granular pigment, which is unevenly distributed in the different cells.

To one who has been devoting considerable time and attention to the eye of Arthropoda, this proposition is particularly striking and unexpected, and many points at once occur which show that it is untenable.

In the first place it is untenable because we have ample evidence to show that the original theory is the true one. The nerve-end cells throughout the animal kingdom have certain definite characteristics. They are the cells in which the ultimate fibrils of the optic nerve terminate, and no nerve fibrils have ever been seen to leave them to supply other parts of the eye; and, in the second place,